AMENDMENTS TO CLAIMS

The following listing of the claims replaces all prior claim versions and listings.

1. **(Currently Amended)** A fingerprint authentication method comprising:

a first step of collating features of input data based on a fingerprint input by ~~an~~ a user with features of enrolled data;

a second step of judging whether the input data are proper for authentication or not, said second step using a spatial frequency analysis of an input image represented by the input data; and

a third step of authenticating the input data according to results of said first step and said second step; wherein

said second step ~~is done by the use of a spatial frequency analysis of an input image represented by the input data~~ comprises:

a fourth step of deciding a rectangular observation area on the input image;

a fifth step of finding a Fourier transformed image from the input image;

a sixth step of calculating feature values on the basis of plural frequency bands derived from the Fourier transformed image, said feature values representing features of the spatial frequency distribution of brightness of the input image; and

a seventh step of deciding whether the input data are proper for the authentication or not on the basis of the feature values, wherein said sixth step is done by the use of variance of strength values corresponding to two predetermined spatial frequency bands in the Fourier transformed image.

2. **(Canceled)**

3. **(Currently Amended)** A fingerprint authentication method as claimed in Claim ~~2~~1,

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wherein said seventh step is done by the use of one or more ~~discriminants~~ discriminant functions and corresponding discriminative coefficients which are previously calculated by the use of the discriminant functions, the discriminant functions being for finding a characteristic value according to the feature values, and the characteristic value being used for deciding whether the input data are proper for the authentication or not.

4. − 5. (Canceled)

6. (Currently Amended) A fingerprint authentication method as claimed in Claims ~~5~~1, or 3, wherein said predetermined spatial frequency bands includes ~~a~~ two spatial ~~frequency~~ frequencies corresponding to a generic period of ridges of a human fingerprint.

7. (Currently Amended) A fingerprint authentication method as claimed in Claims ~~5~~1, or 3, wherein said predetermined spatial frequency bands includes ~~a~~ two spatial ~~frequency~~ frequencies corresponding to a generic period of a periodic structure caused by sweat glands of a human finger.

8. − 11. (Canceled)

12. (Currently Amended) A computer readable program for making a computer system serve as a finger~~print~~ authentication device, comprising:

a first step of collating features of input data based on a fingerprint input by ~~an~~ a user with features of enrolled data;

a second step of judging whether the input data are proper for authentication or not, said second step using a spatial frequency analysis of an input image represented by the input data; and

a third step of authenticating the input data according to results of said first step and said second step; wherein said second step ~~is done by the use of a spatial frequency analysis of an~~

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~~input image represented by the input data~~comprises:

a fourth step of deciding a rectangular observation area on the input image;

a fifth step of finding a Fourier transformed image from the input image;

a sixth step of calculating feature values on the basis of plural frequency bands derived from the Fourier transformed image, said feature values representing features of the spatial frequency distribution of the brightness of the input image; and

a seventh step of deciding whether the input data are proper for the authentication or not on the basis of the feature values, wherein said sixth step is done by the use of variance of strength values corresponding to two predetermined spatial frequency bands in the Fourier transformed image.

13. (Canceled)

14. (Currently Amended) A computer readable program as claimed in Claim ~~13~~12, wherein said seventh step is done by the use of one or more ~~discriminants~~ discriminant functions and corresponding discriminative coefficients which are previously calculated by the use of the discriminant functions, the discriminant functions being for finding a characteristic value according to the feature values, and the characteristic value being used for deciding whether the input data are proper for the authentication or not.

15. – 16. (Canceled)

17. (Currently Amended) A computer readable program as claimed in Claims ~~16~~12, or 14, wherein said predetermined spatial frequency bands includes ~~a~~two spatial ~~frequency~~ frequencies corresponding to a generic period of ridges of a human fingerprint.

18. (Currently Amended) A computer readable program as claimed in Claims ~~16~~12, or 14, wherein said predetermined spatial frequency bands includes ~~a~~two spatial ~~frequency~~

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frequencies corresponding to a generic period of a periodic structure caused by sweat glands of a human finger.

19. – 22. (Canceled)

23. (Currently Amended) A fingerprint authentication device comprising:

a collating portion for collating features of input data based on a fingerprint input by ~~an~~ a user with features of enrolled data;

a characteristic judging portion for judging whether the input data are proper for authentication or not, said characteristic judging portion uses a spatial frequency analysis of an input image represented by the input data to judge whether the input data are proper for authentication or not; and

an authenticating judging portion for authenticating the input data according to outputs from said collation portion and said characteristic judging portion; wherein

said characteristic judging portion comprises ~~uses a spatial frequency analysis of an input image represented by the input data to judge whether the input data are proper for authentication or not~~

an observation area deciding portion for deciding an observation area on the input image;

a frequency analyzing portion for transforming an image of the observation area into a Fourier transformed image;

a feature value calculating portion for calculating feature values on the basis of plural frequency bands derived from the Fourier transformed image, said feature values representing features of the spatial frequency distribution of brightness of the input image; and

a deciding portion for deciding whether the input data are proper for the authentication or not on the basis of the feature values, wherein said feature value calculating portion uses variance

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of strength values corresponding to two predetermined spatial frequency bands in the Fourier transformed image.

24. (Canceled)

25. (**Currently Amended**) A fingerprint authentication device as claimed in Claim ~~24~~23, further comprises a discriminative coefficient holding portion for holding one or more ~~discriminants~~ discriminant functions and corresponding discriminative coefficients which are previously calculated by the use of said ~~discriminants~~discriminant functions, the discriminant functions being for finding a characteristic value according to the feature values, and the characteristic value being used for deciding~~wherein~~

~~said deciding portion uses said discriminants and said discriminative coefficients together~~ ~~with the discriminative values to decide~~ whether the input data are proper for the authentication or not.

26. – 27. (Canceled)

28. (**Currently Amended**) A fingerprint authentication device as claimed in Claim ~~27~~23, wherein said predetermined spatial frequency band~~s~~ includes ~~a~~two spatial ~~frequency~~ frequencies corresponding to a generic period of ridges of a human fingerprint.

29. (**Currently Amended**) A fingerprint authentication device as claimed in Claim~~s~~ ~~27~~23 or 25, wherein said predetermined spatial frequency band~~s~~ includes ~~a~~two spatial ~~frequency~~ frequencies corresponding to a generic period of a periodic structure caused by sweat glands of a human finger.

30. – 33. (Canceled)

34. (**New**) A fingerprint authentication method as claimed in claims 1 or 3, wherein the discriminant function and the corresponding discriminative coefficients are decided by learning

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using learning data sets of fingerprints.

35. (New) A fingerprint authentication method as claimed in claims 1, or 3, wherein the discriminant functions weight the feature values with the discriminative coefficients and add the weighted feature values to find the characteristic value.

36. (New) A fingerprint authentication method as claimed in claims 1, or 3, wherein each of the feature values is a difference/ratio between/of values of the variance of the two predetermined spatial frequency bands.

37. (New) A computer readable program as claimed in claims 12 or 14, wherein the discriminant functions and the corresponding discriminative coefficients are decided by learning using learning data sets of fingerprints.

38. (New) A computer readable program as claimed in claims 12, or 14, wherein the discriminant functions weight the feature values with the discriminative coefficients and add the weighted feature values to find the characteristic value.

39. (New) A computer readable program as claimed in claims 12, or 14, wherein each of the feature values is a difference/ratio between/of values of the variance of the two predetermined spatial frequency bands.

40. (New) A fingerprint authentication device as claimed in claims 23 or 25, wherein the discriminant functions and the corresponding discriminative coefficients are decided by learning using learning data sets of fingerprints.

41. (New) A fingerprint authentication device as claimed in claims 23, or 25, wherein the discriminant functions weight the feature values with the discriminative coefficients and add the weighted feature values to find the characteristic value.

42. (New) A fingerprint authentication device as claimed in claims 23, or 25, wherein

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each of the feature values is a difference/ratio between/of values of the variance of the two predetermined spatial frequency bands.